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The Abo Human Blood Groups and Skeletal Class IIi Malocclusions

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THE ABO HUMAN BLOOD GROUPS AND SKELETAL CLASS III MALOCCLUSIONS

by

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LIFE

Patrick Michael Flannery was born in South Bend, Indiana on July 15, 1926. He was graduated from Hirsch High School, Chicago, Illinois in June 1944. He enlisted in the United States Army with his twin brother following graduation. Together they served as riflemen in the 100th Infantry Division of the United States 7th Army in the European Theater of Operations.

In 1946 he entered pre-dental training at Morgan Park College, Chicago, Illinois. In September 1949, he entered Chicago College of Dental Surgery, Loyola University, and received the degree of Doctor of Dental Surgery in June 1953.

After fourteen years in the practice of dentistry, he enrolled in the graduate school of Orthodontics at Loyola University, Chicago, Illinois in June 1967.

He is single, and resides with his mother and brother.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER I

INTRODUCTION

A. Introductory Remarks and Statement of the Problem

Dental malocclusion is a morphologic deviation of a biophysical nature from an accepted norm for the human species. It is not always easy to determine what is normal and what is a malformation or a deviation from the norm because the head and face show more independent variance from the rest of the body than any of the other parts. The face, in particular, shows more dysplasia and disharmony than any other region of the body. In 1100 children, Hellman found 60 percent to have normal occlusion at 4 years of age, but only 22 percent had normal occlusion at 9 years of age, the percentage rising somewhat thereafter.

The purpose of this research is to investigate the possible existence of a relationship between the ABO human blood groups, the Rh factor and hereditary malocclusions of the skeletal type Class III.

Skeletal type refers to the inherited bony size, position, and form of the upper and lower jaw to each other, while Class III skeletal type refers to a lower jaw which is either larger bodily than normal or situated further forward to an abnormal degree as evidenced by a cephalometric analysis. The profile is prognathic at the mandible.

There had been no previous research in this precise area until Schnibben (1968) analyzed the relationship in the skeletal type, Class II, Division I. Various studies have been carried out on other physical characteristics of various peoples.

B. Review of the Literature

The year 1900 saw the laws of heredity proposed by Gregor Mendel in 1865 rediscovered. These rules of inheritance have been shown to apply fully to the blood groups, of which Landsteiner also in 1900 discovered three of four blood groups of the ABO system. He showed that the red corpuscles of certain persons were agglutinated by the sera of certain other persons but not by their own sera. Until 1900, however, no worker seems to have considered the possibility that the plasma of healthy members of any one species, whether man or animal, might contain or be made to develop antibodies active against the red corpuscles of other members of the same species.

The discovery of effects due to the presence of A and B antigens in secretions was made by Yamakami (1926) but the phenomenon only became clearly understood as a result of the investigation of Lehrs (1930) and Putkanen (1930) on saliva. Their work led to very extensive investigations of the biochemistry of the blood group antigens, and that these antigens and other blood group antigens were confined to the surface of the red blood corpuscle.

The distribution of the blood groups has been accomplished in detail by the writer Mourant (1954). The average frequencies of the genes of the ABO system vary systematically from one major region to another. For example, universally the most common gene in nearly all areas is O. In Europe, the A gene comes next in frequency and B is realtively rare. In Africa, A exceeds B but is rarer than in Europe, B being somewhat more common. In Asia generally, B is more common than anywhere else in the world and frequently exceeds A. Several suggestions were put forth in regard to variations in frequency of the blood group system. One of these was based on the assumption that blood groups were little, if at all, affected by natural selection, and that frequency differences arose at an early stage of human history, when man was still a rare creature and variations could develop in small families or tribal groups. Other workers, especially Sir Ronald Fisher and Dr. E. B. Ford regarded it as probable that the variations were the result of natural selection.

The newly rediscovered heredity laws of Mendel were almost as slow as knowledge of the blood groups to penetrate into the mainstream of scientific thought, but ten years after Landsteiner's discovery, von Dungern and Hirszfeld (1910) showed that the blood groups were inherited as Mendelian characters though not until fourteen years later still did Bernstein (1924) describe their precise mode of inheritance which depends upon the existence of three allelomorphic genes: A,

B, and O.

The following are the gene combinations in the different blood groups:

Genes present in individual	Blood group
O O	O
A O	A
A A	A
A B	AB
B O	B
B B	B

Other blood group systems were discovered including the Rh blood groups in 1927. These systems were put to rapid and extensive clinical and anthropological application. The statistics for the ABO system are the result of some 4,000 surveys, covering many millions of persons, mostly blood donors.

The general mechanisms of genetic change in a population are mutation, selection, mixture, and drift. The exact mechanisms of genetic transmission between individuals has been worked out only for certain specific characteristics.

According to Dobzhansky (1959), the individual never fully realizes the genetic pattern in postnatal life. Human potentialities are determined by the genotype, but their manifestation depends on environment.

There are three types of transmission of malocculsion from the standpoint of genetics, according to Dobzhansky (1959):

1. Repetitive - The recurrence of a single dentofacial deviation within the immediate family and in the progenitors.

2. Discontinuous - The recurrence of a tendency for a malocclusal trait to reappear within the family background over several generations.

3. Variable - Tne occurence of different but related types of malocclusion within several generations of the same family.

As an etiologic factor in malocclusion, genetics must be approached on an organismic rather than a molecular or biochemical level. Salzman (1966) states, in order for an anomaly to be considered of hereditary origin, it should occur and be a well defined variation in family groups. A diagnosis of genetic malocclusion should not be made on the basis of a single case of recurrence in the family.

Evidence of genetic responsibility as the etiologic factor in the production of any anomaly can be frequently masked by environmental conditions such as climate, economic conditions, hygiene, and other variables.

Salzman (1966) states that Stockard's (1931) findings on the cross-breeding of pure-bred dogs suggests that the growth of the upper and lower jaws are independent of one another. One set of genes predetermines the structural pattern of the maxilla, and another set of genes for the mandible.

Salzman further states that Montagu (1963) suggests that since the expression of heredity is the function of the environment, it is to a certain extent subject to human control. We can influence the development of hereditary characteristics by changing the environment of a person.

Dobzhansky (1954) found that the growth pattern posesses a genetically determined plasticity which makes it possible for environmental conditions to influence it. Therefore, orthodontists should not hesitate in their attempts to change or forestall abnormalities of genetic origin in the dento-facial area.

Neel (1961) found that not more than 20 percent of all malformations were of genetic origin, while 60 percent of defects can be attributed to environmental causes.

In his discussion of the Aleut dentition, Moorrees (1957) states that a greater bizygomatic width occurred in the Eastern Aleut over the Western Aleut. The Eastern Aleut also exhibited a greater facial height, and a higher frequency of blood groups O, B, and type N.

Many well known internal diseases such as mentioned by Muschel (1966) which are related to and affected by the blood groups include ulcers, cancer of the gastrointestinal tract, pernicious anemia, poliomyelitis, broncho-pneumonia, and viral infections. In addition, Vogel (1964) has named such infectious diseases as syphillis, tuberculosis, virus infections such as acute hepatitis, and infant diarrhoea as all showing a definite

relationship with the ABO blood groups.

CHAPTER II

METHODS AND MATERIALS

A. Selection of Subjects

Subjects for this investigation were selected from patients and students at the Loyola University, School of Dentistry, Department of Orthodontics and Oral Surgery; and from students attending the dental school.

The group studied included both males and females of the Caucasian, Negro, and Oriental races, who exhibited a hereditary malocclusion of the skeletal type Class III. A similar control group was used, comprised of subjects exhibiting a Class I arch length discrepancy type malocclusion.

The clinical manifestation of a skeletal type Class III, as classified by Angle, exhibits morphologic deviation of various combinations and degrees, among which are the following:

1. The mandibles show an over-developed, wide, straight ascending ramus and equally wide body.

2. The body is of normal length or perhaps slightly larger than normal.

3. The inferior border of the body gives a rocking chair appearance.

4. The angle (gonial) described between the body and the ramus is more acute.

5. The Frankfort mandibular plane angle is low, often only 15 degrees or less.

6. The symphysis is prominent, and the angle of the mandibular incisors to the mandibular plane is often less than 90 degrees.

7. The depth of the maxilla is below the normal range with B point anterior to A point yielding a negative ANB difference.

The control group consisted of subjects possessing a Class I arch length discrepancy type malocclusion. This is characterized by a normal first molar relationship, arch length deficiency, which makes it impossible to accommodate the teeth in the dental arches in regular alignment and is the main problem in Class I (Angle) malocclusion. Irregular incisor alignment, blocked out teeth, and posterior crossbites are the usual dento-alveolar findings. Since this malformation is not of the skeletal type, the maxilla and mandible are generally well related to each other and to cranial anatomy.

B. Method of Blood Testing

Immunology is usually defined as the study of resistence to infectious disease; its subdivision, serology, is the study of antisera, or more properly, the study of the anti-bodies elicited by the infectious disease process.

The two most frequently used terms in immunology and serology are antigen and anti-body. Both are mutually dependent on the other for an antigen can only be recognized by its anti-body and vice-versa. An antigen has been defined as a substance which when introduced into the body of an animal, stimulates the production of anti-bodies and can usually react in an observable fashion with the anti-body. As can be seen, the statement also defines the term anti-body.

Most antigens are high molecular weight compounds, usually protein in nature, and their reactions with anti-bodies are usually highly specific.

Specifically, anti-bodies are found in the globulin portion of serum or plasma. As a result of their presence, combination occurs when the anti-body containing serum of the individual is placed in contact with the antigen. The combination of antigen and anti-body usually produces some visible effect.

Landsteiner found that the red blood corpuscles of man may contain two distinct antigens, and the letters A and B were chosen to represent them. These antigens reside on the surface of the red blood corpuscles. Persons with type O blood possess neither of these antigens, type A persons have the A antigen, type B persons have the B antigen, and type AB persons possess both.

Depending upon which blood group antigen is present on

the red blood corpuscles, the reciprocal anti-body is found in the plasma. When the A antigen is found on the red blood corpuscle, anti-B will be present in the plasma; when the B antigen is on the red blood corpuscles, anti-A will be found in the plasma. When there are no antigens present on the corpuscles, as in blood group O, then both anti-A and anti-B anti-bodies will be found in the plasma. For AB blood group, just the opposite will be true.

The anti-body found by Levine and Stetson in 1939, in the serum of a recently delivered woman, was recognized as the antigen now known as Rh_0 or D. The authors postulated that the anti-body had been produced by an antigen present in the fetal red corpuscles and inherited from the father. Consequently, when transfused with her husband's blood, the patient suffered a hemolytic reaction. This anti-body was later shown to be identical in specificity with the Rh anti-body produced in rabbits by the injection of the red corpuscles of the Rhesus monkey. Both of these anti-bodies, when used to test saline suspensions of adult red corpuscles, give corresponding reactions and divided the donors of the corpuscles into 85 percent positive and 15 percent negative. Those positive with the antisera were termed Rh positive, those negative were called Rh negative.

Blood group determination of the subjects was made with anti-A sera, anti-B sera, and Rh determination by anti-D sera.

In addition, a control system Rh determination, in which the subjects' corpuscles were tested with a Bovine albumin 22 percent solution in addition to the anti-D test serum, in order that Rh negative subjects could not be classified erroneously as Rh positive.

Blood type and Rh factor of each of the subjects was determined by the following procedure:

1. The subjects' left ring finger was wiped with 70 percent alcohol and was pierced by a sterile lancet.

2. A glass microscope slide was divided in half with a marking pencil and one drop of blood was placed on each side to which was added one drop of anti-A sera (to the first drop), and one drop of anti-B sera (to the second drop).

3. In a similar manner, another glass slide was used, with a drop of blood on each side. To the left side was added one drop of anti-D sera and to the right side, one drop of control solution.

4. Each was mixed using a clean tooth pick, and the slide rotated and tilted back and forth. The procedure was carried out at room temperature.

5. The slide was immediately examined for agglutination of red blood corpuscles.

6. A double positive reaction, e.g., agglutination with both anti-D test sera and the control Bovine albumin indi-

cates the presence of auto-anti-body, and required further testing.

There are a great many blood grouping techniques. The direct open slide method was employed for its speed and simplicity.

Agglutination reactions for the blood groups were usually rapid, and identification quickly determined.

Table 1 shows the possibilities obtainable in the testing procedure for both blood grouping and the Rh determination. The results were plotted in graph form as shown in Table 2. The figures for the skeletal test group and the Class I control group were compared to each other and to the United States National Averages for Caucasians, using the chi square formula: $X^2 = \frac{\Sigma(O-T)^2}{T}$.

Table 1

RESULTS POSSIBLE FROM TESTING

SPECIMEN	ANTI-A SERA	ANTI-B SERA	INTERPRETATION
No. 1	0	0	TYPE O
No. 2	+	0	TYPE A
No. 3	0	+	TYPE B
No. 4	+	+	TYPE AB

0 NO AGGLUTINATION

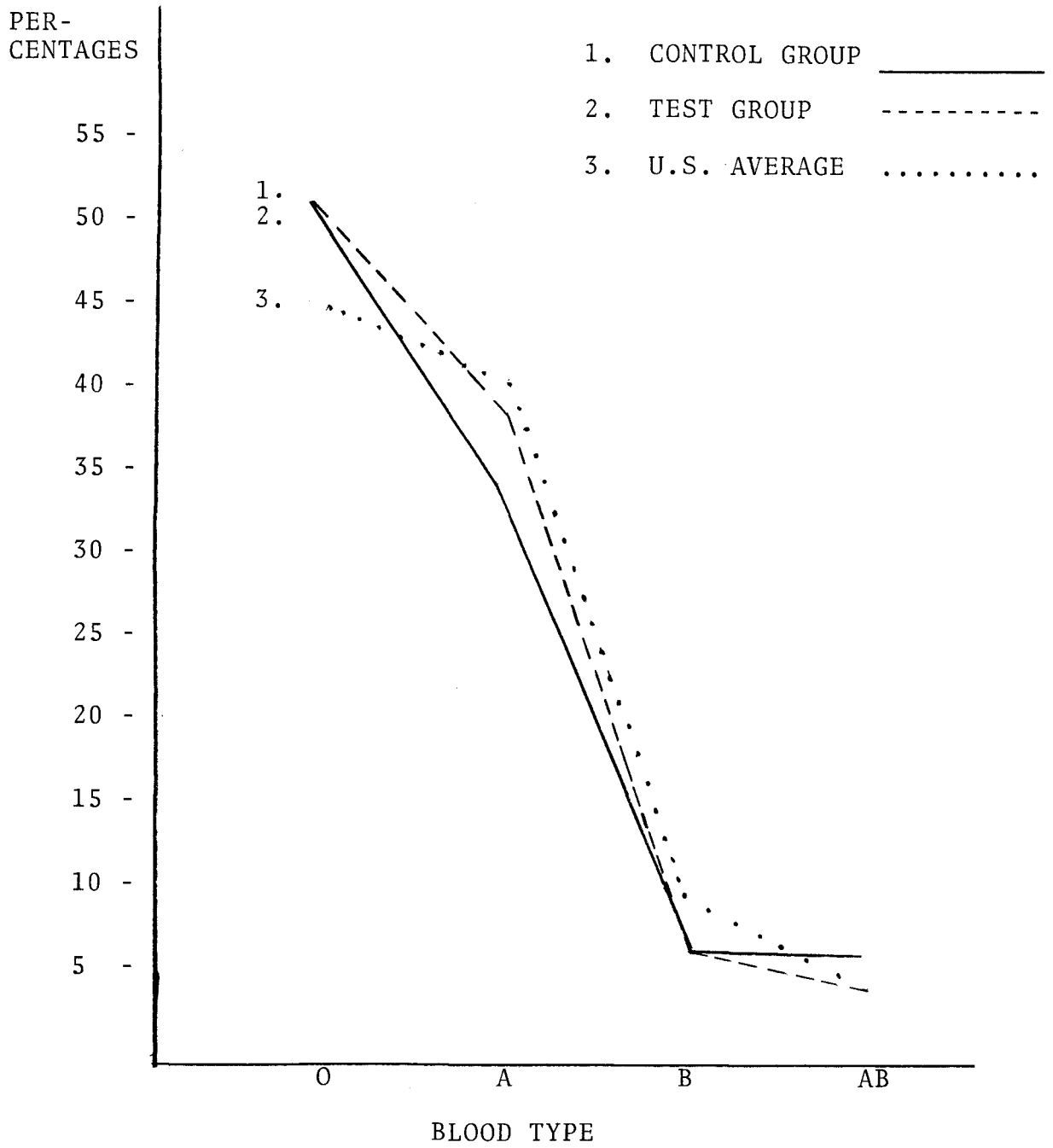
\+ AGGLUTINATION

SPECIMEN	ANTI-D Rh SERA	BOVINE CONTROL	INTERPRETATION
No. 1	+	0	Rh POSITIVE
No. 2	0	0	Rh NEGATIVE
No. 3	+	+	QUESTIONABLE*

*FURTHER TESTING REQUIRED

Table 2

GRAPH DEPICTING RANGE OF SUBJECTS TESTED



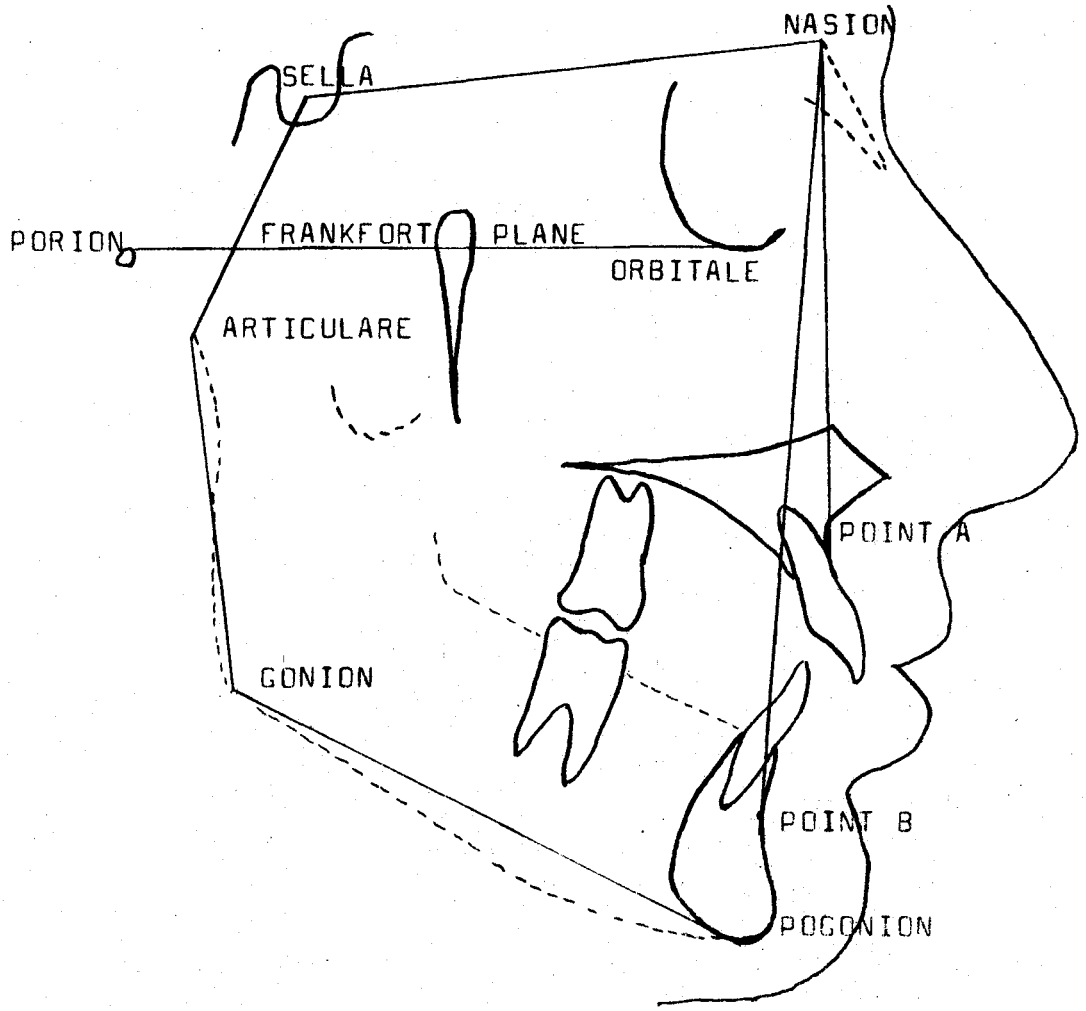


Figure 1 Skeletal Landmarks Used

Figure 2 Frontal View of a Class I Control Subject

Figure 3 Profile View of a Class I Control Subject

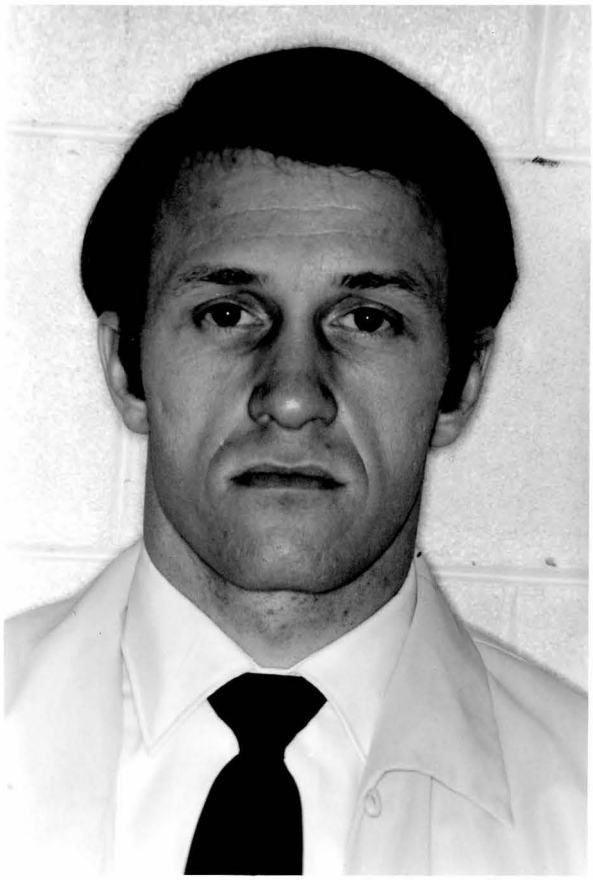


Figure 4

Frontal View of a Skeletal Type Class III

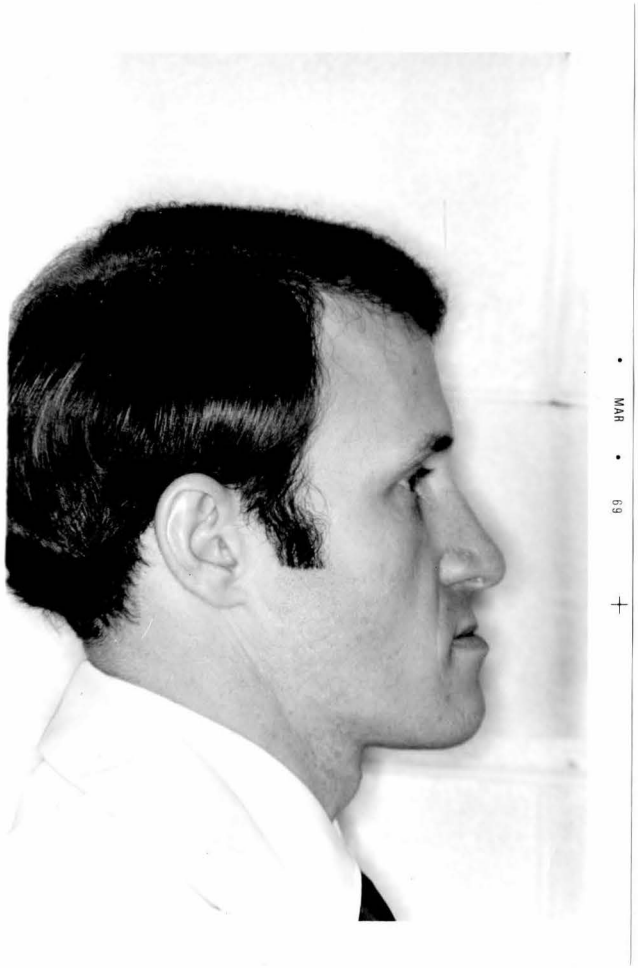


Figure 5

Profile View of a Skeletal Type Class III

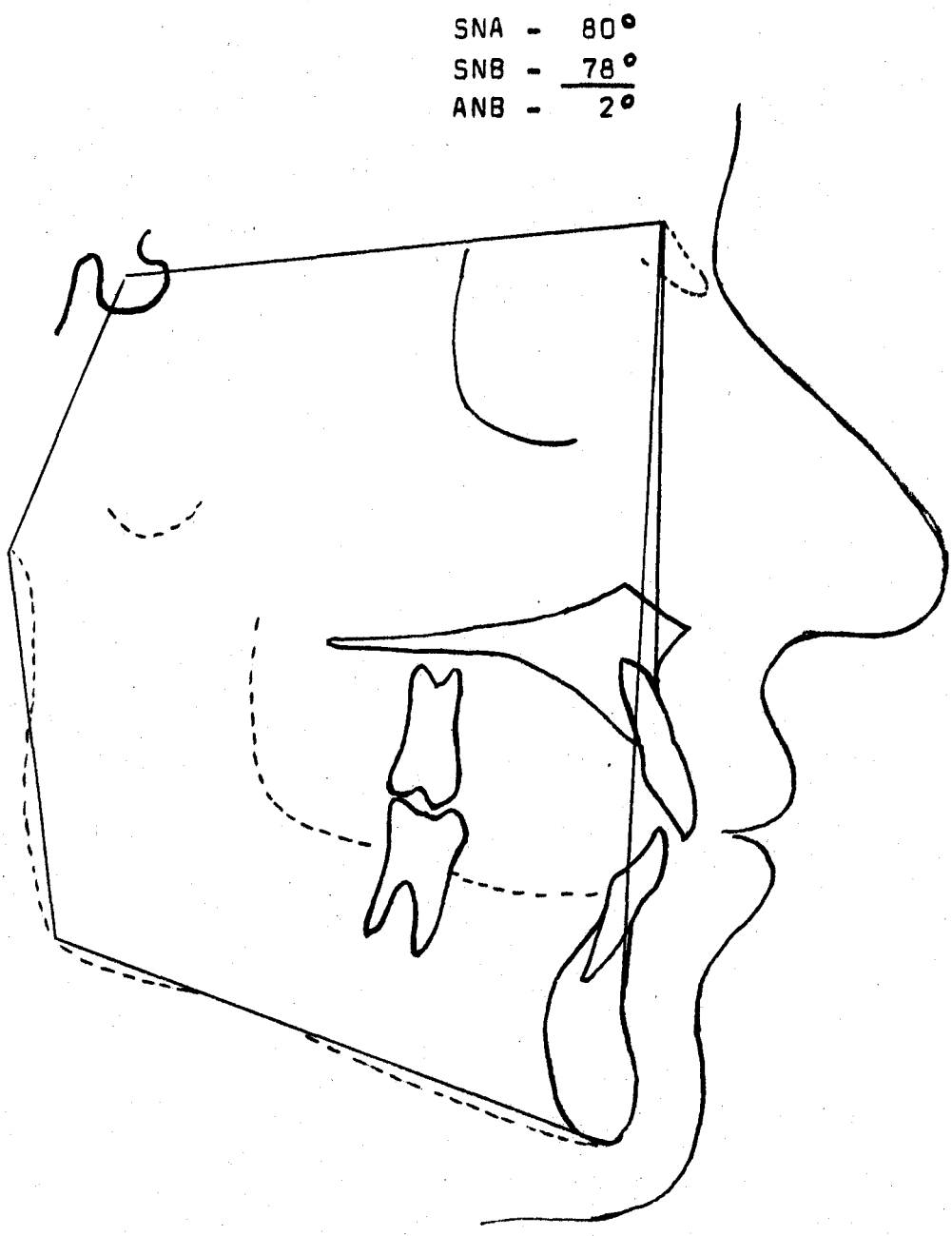


Figure 6

Lateral Headplate Tracing of a Class I Control Group Subject

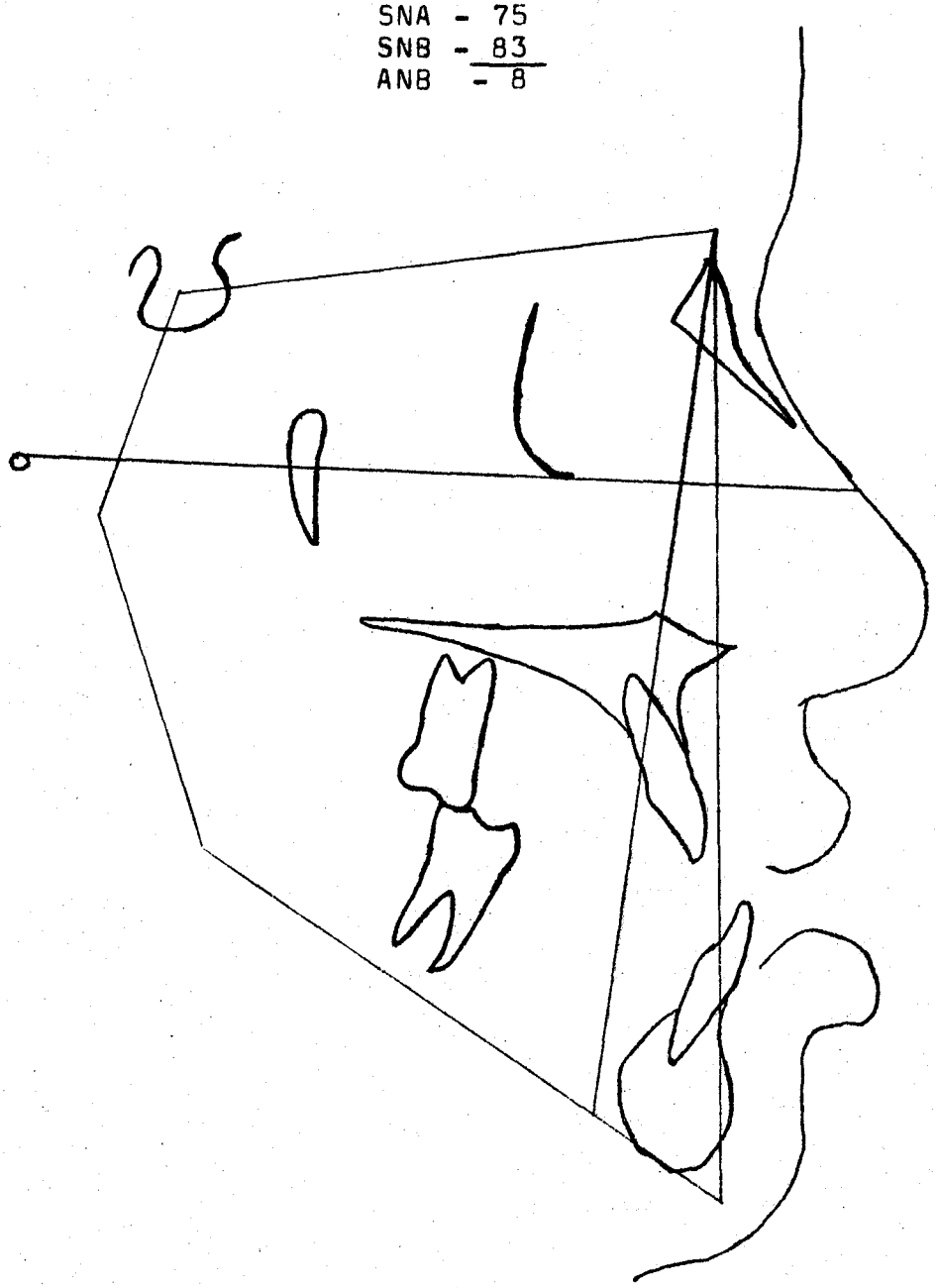


Figure 7

Lateral Headplate Tracing of a Skeletal Type Class III

Table 3

CLASS I CONTROL GROUP

BLOOD TYPE	SUBJECTS	RH+	RH-	% RH+	% RH-	% TOTAL
A	34	25	9	25	9	34
B	7	6	1	6	1	7
O	52	41	11	41	11	52
AB	7	7	0	7	0	7
TOTAL	100	79	21			

CLASS III SKELETAL GROUP

A	19	17	2	38	4	38
B	3	3	0	6	0	0
O	26	23	3	46	6	52
AB	2	1	1	2	2	4
TOTAL	50	44	6			

NATIONAL AVERAGES UNITED STATES

BLOOD TYPE	% of TOTAL	% RH
A	41	
B	10	
O	45	Rh+ 85%
AB	4	Rh^- 15%

Table 4

CHI SQUARE TABLE OF SIGNIFICANCE

	GROUP	GROUP	CHI^2
1.	SKELETAL	CONTROL	.941 *
2.	SKELETAL	U.S. AVERAGE**	1.403 *
3.	CONTROL	U.S. AVERAGE	5.436 *
4.	SKELETAL Rh^-	CONTROL Rh^-	6.352 *
5.	SKELETAL Rh^-	U.S. AVERAGE Rh^-	.260 *
6.	CONTROL Rh^-	U.S. AVERAGE Rh^-	2.823 *
7.	SKELETAL O	CONTROL NON-O	0.000 *
8.	SKELETAL A	CONTROL NON-A	.356 *
9.	SKELETAL B	CONTROL NON-B	1.180 *
10.	SKELETAL AB	CONTROL NON-AB	.645 *
11.	SKELETAL O	U.S. AVERAGE NON-O	.910 *
12.	SKELETAL A	U.S. AVERAGE NON-A	.181 *
13.	SKELETAL B	U.S. AVERAGE NON-B	.880 *
14.	SKELETAL AB	U.S. AVERAGE NON-AB	0.000 *
15.	CONTROL O	U.S. AVERAGE NON-O	1.979 *
16.	CONTROL A	U.S. AVERAGE NON-A	1.618 *
17.	CONTROL B	U.S. AVERAGE NON-B	1.000 *
18.	CONTROL AB	U.S. AVERAGE NON-AB	2.343 *

* Not Significant

**U.S. Average for Caucasians

Table 5

INCIDENCE OF APPEARANCE OF BLOOD GROUPS AND Rh FACTOR

BY RANDOM SELECTION

CLASS I CONTROL GROUP

1.	A	34.	B-	67.	A
2.	A	35.	O	68.	A
3.	AB	36.	A	69.	A-
4.	O	37.	A	70.	O
5.	O	38.	O	71.	O
6.	O	39.	O	72.	A
7.	A-	40.	A-	73.	B
8.	A	41.	O	74.	AB
9.	A-	42.	A	75.	A
10.	A	43.	A	76.	A-
11.	O-	44.	B	77.	A
12.	A	45.	O	78.	O
13.	O	46.	O	79.	O
14.	O-	47.	O	80.	A
15.	O	48.	O-	81.	O
16.	O	49.	A	82.	AB
17.	A	50.	O	83.	O-
18.	AB	51.	O	84.	A
19.	A	52.	O	85.	A
20.	O	53.	O	86.	O
21.	A-	54.	B	87.	AB
22.	O	55.	A	88.	A
23.	O	56.	B	89.	O
24.	O	57.	O	90.	A
25.	O	58.	O	91.	B
26.	O	59.	O	92.	A
27.	O	60.	AB	93.	A-
28.	O	61.	B	94.	O-
29.	O	62.	O	95.	O-
30.	A-	63.	O-	96.	O-
31.	O	64.	O-	97.	AB
32.	O	65.	A-	98.	O
33.	O	66.	O-	99.	O-
				100.	A

Table 6

INCIDENCE OF APPEARANCE OF BLOOD GROUPS AND Rh FACTOR BY RANDOM SELECTION

CLASS III SKELETAL GROUPS

1. O-	17. O	34. O
2. O	18. O	35. A-
3. O	19. O	36. A-
4. O	20. B	37. O
5. O-	21. A	38. A
6. O	22. O	39. B
7. A	23. O-	40. A
8. AB	24. O	41. O
9. AB	25. B	42. A
10. A	26. O	43. A
11. A	27. O	44. A
12. A	28. A	45. O
13. A	29. A	46. O
14. A	30. A	47. A
15. O	31. O	48. A
16. O	32. O	49. O
	33. O	50. A

CHAPTER III

FINDINGS

There were 4 percent more subjects with type A blood in the skeletal test group than in the Class I control group, also the skeletal group blood type A was 3 percent below the national averages for caucasions.

Skeletal test subjects with type B blood were only 1 percent less than those of B type control subjects, and 4 percent less than the national averages.

Type O blood subjects showed the greatest variation with 52 percent showing up in both the class I control group and the skeletal test group. This group was 7 percent above the national average figure.

The Rh determination of the skeletal test group, 88 percent proved to be Rh+, and 12 percent were Rh^-, as compared to the control group which showed to be 79 percent Rh+ and 21 percent Rh^-. The skeletal test group therefore came within 3 percent of the national average figure, closer than did the class I control group which fell 5 percent below the national figure.

CHAPTER IV

DISCUSSION

The graph of Table 1 depiciting the range of subjects tested, along with the statistics in Table 2 indicate that the skeletal Class III test group subjects, and the control group almost superimpose one another, in addition, they run a parallel course, and lie slightly inside the United States National Averages figures. When the individual blood groups of the test groups and the control group are added together and averaged, they fall very closely to the United States National Averages.

All blood groups tested showed no significance when comparing the skeletal test group to the control group. The skeletal test group as a whole approached the United States National Average figures closer than did the control group.

Although there were a higher number of subjects in the skeletal test group with type A blood than in the control group, both groups fell short of the National Average figures. Yet, if the next three subjects had tested out as type A, the test group would have reached the National Average figure. Similarily, type O exhibiting the same percentage in both the skeletal and control group, but exceeding by some 7 percent the National Average figure would then have very closely reached the exact percentage of the United States National Average.

CHAPTER V

SUMMARY AND CONCLUSIONS

A. Summary

A research project was undertaken to investigate the possible existence of a relationship between the ABO human blood groups, the Rh factor and hereditary malocclusions of the skeletal type Class III. A control group composed of Class I arch length discrepancy subjects was used. The skeletal test group was composed of fifty subjects, the control group 100 subjects. The subjects were male and female of Caucasian, Negro, and Oriental race.

The direct open slide method was used for the gross determination of the blood groups. Blood groups identification was determined by agglutination reaction with fresh whole blood and anti-A and anti-B sera. Rh determination was established by the use of anti-D sera.

The statistics obtained were examined using the Chi square formula for comparison. It was found that the skeletal test group and the Class I control group were nearly superimposed and closely paralleled the course for the United States National Averages for Caucasians. When the skeletal test group and the control group were added together they made up the National Average.

B. Conclusions

The conclusions that can be stated from the findings in the experiment show the following: (1) The skeletal test group and the control group nearly superimpose one another. (2) These two groups fall just short of the National Average figures, but when totaled together come very close to making up the National Average figures.

Statistics tells us that the number of subjects tested was sufficient to rule out errors in the size of the sample tested. There were 18 statistical computations using the chi square formula. None proved to show significant value. From this investigation it appears that there is no direct genetic link or influence of the blood group antigens on the development of the skeletal pattern of the jaws of the Class III nature.

The data obtained in a biological experiment are subject to variation, chance and random events, factors which occur in our daily lives. Just what the characteristics of the individual will be are set forth by the natural laws of heredity, variation, and natural selection, which play the determining roles.

BIBLIOGRAPHY

Dobzhansky, T., "Evolution At Work"; Science: 127:1958, pp. 1091-1096.

McFarlane, Robb-Smith, Functions of the Blood. Academic Press, 1961.

Moorrees, C.F.A., The Aleut Dentition. Harvard University Press, 1957.

Mourant, A.E. "The Distribution of the Human Blood Groups"; Oxford: Blackwell Scientific Publications #1380139, pp. 33-44.

Muschel, L.H. "Blood Groups, Disease and Selection"; Bacteriological Reviews, 30:2 (June, 1966).

Neel, J.V. "Some Genetic Aspects of Congenital Defects"; Fishbein Med. ed.: First International Congress Conference on Congenital Malformations. Philadephia: Lippincott, 1961, p. 63.

Salzman, J.A. Practice of Orthodontics. Philadelphia: Lippincott, 1966, pp. 256-271.

Schnibben, C.L. "A Study of the Relationships of the ABO Human Blood Groups, the Rh Factor and Hereditary Malocclusions of the Skeletal Type, Class II, Division 1. M.S. Thesis, Loyola University, Chicago, Illinois, 1968.

Stockard, C.R. "The Genetic and Endocrine Basis for Differences in Form and Behavior as Elucidated by Studies of Contrasted Pure Line Dog Breeds and Their Hybrids". The Wistar Institute of Anatomy and Biology. 1941

Vogel, F. "Blood Groups and Natural Selection". Proc. 10th Congr. Int. Soc. Blood Transf., Stockholm, 1964; pp. 268-279 (1965).

APPROVAL SHEET

The thesis submitted by Dr. Patrick Michael Flannery has been read and approved by members of the Department of Oral Biology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science.

May 20, 1969
Date

G. W. Cayer, D.D.S.
Signature of Advisor